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THE UPPER DEVONIAN AND LOWER MISSISSIPPIAN OF SOUTHWESTERN PENNSYLVANIA

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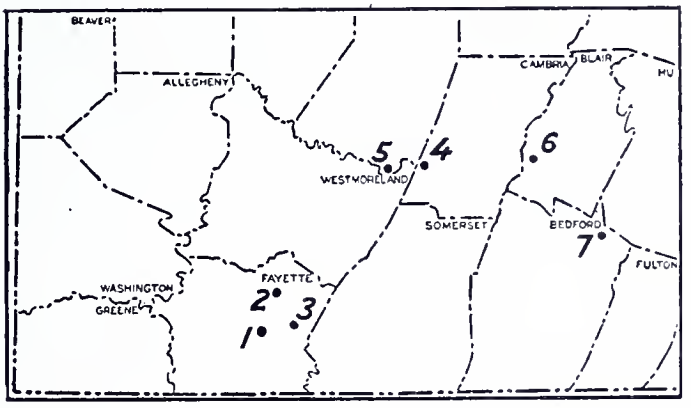

Location of sections discussed.

1. Summit Hotel
2. Youghiogheny, Chestnut Ridge
3. Youghiogheny, Laurel Hill
4. Conemaugh, Laurel Hill
5. Conemaugh, Chestnut Ridge
6. Allegheny Front
7. Riddlesburg

CONTENTS

	Page
Introduction	1
Literature Survey	2
Upper Devonian facies relationships	4
Detailed stratigraphy	5
Devonian system	8
Chautauquan series	8
Conneaut (Chadakoin) stage (?)	8
Sandstone A	8
Conewango series	9
Venango stage	9
Sandstone B	9
Shale C	11
Riceville stage (?)	11
Sandstone D	11
Mississippian system	12
Oil Lake series	12
Cussewago stage	12
Sandstone E	12
Conglomerate F	14
Sandstone G	14
Sandstone H	15
Berea stage	16
Conglomerate I	16
Kinderhook series	16
Shenango and Meadville stages (?)	16
Sandstone J	16
Paleontological considerations	17

TABLES

Table	I	Stratigraphic units of the Upper Devonian and Lower Mississippian of southwestern Pennsylvania	5
	II	Stratigraphic section exposed in the Youghiogheny gorge through Laurel Hill	6
	III	Biotic chart of the Upper Devonian and the Lower Mississippian of southwestern Pennsylvania	18

ILLUSTRATIONS

Map showing location of sections discussed
Correlation of geologic sections 13

FOREWORD

For over 50 years it has been held that under Chestnut Ridge and possibly a much larger area all of the uppermost Devonian strata are lacking. If that were true, the lower gas-bearing strata should be several thousand feet nearer the surface rocks than on either side of Chestnut Ridge. The presence or absence of several thousand feet of Devonian strata therefore is a matter of considerable interest as affecting drilling for gas on Chestnut Ridge. The present paper gives many details of the character and sequence of strata previously undescribed and is a substantial contribution toward the solution of the problem.

Mr. Laird's findings greatly strengthen the recent belief that the Upper Devonian rocks are present in normal sequence.

GEO. H. ASHLEY

INTRODUCTION

Problems involved in this study

Several problems are involved in this study of the Devonian and Mississippian stratigraphy of southwestern Pennsylvania. These fall under three main heads. 1. The exact age of the Devonian sequence exposed in the inliers of southwestern Pennsylvania in terms of studied sections in other parts of the State. 2. The age and relationship of the "Pocono" formation of western Pennsylvania. 3. The paleogeographic setting of these formations. This last problem is not considered in this report. With these problems in mind, all possible stratigraphic sections were studied, measured wherever practicable, and fossils carefully collected.

Location

The Upper Devonian and Lower Mississippian rocks are exposed in five localities in the Appalachian Plateau of southwestern Pennsylvania. The best exposures and fossils are found in three anticlinal inliers in Fayette County. Inferior sections and less desirable fossils occur in the gorges of the Conemaugh River through Laurel Hill and Chestnut Ridge.

The Summit inlier is on the crest of Chestnut Ridge in Fayette County about 4½ miles southeast of Uniontown on the National Pike (U. S. Route 40) near the South Union-North Union Township line. This is in the south-central part of the Uniontown quadrangle. The measured sections crop out in cuts along the north bank of the road.

The Youghiogheny gorge inlier (*Chestnut Ridge*) is southeast of Connellsville in Fayette County where the Youghiogheny makes its gorge through Chestnut Ridge along the north boundary of Dunbar Township in the northeastern part of the Uniontown quadrangle. Good sections are exposed on both banks of the river along the tracks of the Baltimore & Ohio Railroad and the Western Maryland Railroad. The best cuts for study occur on the southeast bank of the river along the Western Maryland Railroad.

The Youghiogheny gorge inlier (*Laurel Hill*) is about 3 miles southeast of Ohiopyle, Fayette County, near Victoria, a small flagstop on the Baltimore & Ohio Railroad in the eastern part of Stewart Township and south-central part of the Confluence quadrangle. The entire section from the top of the "Pocono" to the lowest part of the Upper Devonian exposed in any of the inliers can be seen in this locality.

Conemaugh gorge inlier (*Laurel Hill*) is about 5 miles northwest of Johnstown at the junction of Westmoreland, Indiana and Cambria County lines in the west-central part of the Johnstown quadrangle. The best complete section can be obtained along the Pennsylvania Railroad on the northeast bank of the Conemaugh River.

Conemaugh gorge inlier (*Chestnut Ridge*) is the least known of all. It is about 1½ miles east of Torrance in Westmoreland County, which is southeast of Blairsville, on the banks of Conemaugh River in the western part of the New Florence quadrangle.

Acknowledgments

I wish to thank Mr. Fred I. Mason of Ohiopyle, Pennsylvania, for extensive assistanee in the field. Drs. Caster and Bucher of the University of Cincinnati and Columbia University respectively gave valuable assistance and suggestions. Dr. Caster has also read the manuscript. Grateful acknowledgment is also given to the Pennsylvania Geological Survey and to the American Association of Petroleum Geologists for financial assistance.

LITERATURE SURVEY

The most extensive and detailed studies of the Upper Devonian and Lower Mississippian of Pennsylvania have centered in the northwestern part of the State. That area is the locality of reference for all stratigraphic problems related to these systems in other parts of Pennsylvania. Several excellent reports[1] deal with the stratigraphy of the Upper Devonian and Lower Mississippian of that region, which obviates the necessity of reviewing it extensively in this report. However, in as far as feasible the nomenclature outlined by Caster's 1934 paper is followed in the present report.

J. J. Stevenson[2] was the first to report on the Devonian and Mississippian rocks of the southwestern Pennsylvania inliers. His Ligonier Valley report for the Second Geological Survey of Pennsylvania contains brief references to both systems but as these rocks were judged of little economic value, he dealt with them only lightly. At the instance of J. P. Lesley, the State Geologist, the Devonian rocks were termed "Catskill" in the 1877 report although Stevenson had already found fossils in them which he attributed to the "lower Chemung," as he brought out in an independently published article the following year.[3] In this latter article he suggested the possibility that the upper Chemung and the "Catskill" might be missing in this area. The idea of a hiatus by which a large part of the Upper Devonian and the Lower Mississippian is omitted in southwestern Pennsylvania has recurred in the more recent writings of Willard[4] and Chadwick.[5]

When M. R. Campbell[6] mapped the Masontown-Uniontown quadrangles in 1902, he thought that the highest Devonian rocks exposed in the inliers of this area were "Catskill" in age and the geological map for that area was so engraved. Later, however, he reconsidered this age assignment and in the text of the folio he stated that the highest Devonian rocks are of "Chemung" age and that no formation intervenes between them and the "Pocono." He also stated that the "Chemung" is fossiliferous right up to the base of the "Pocono." Campbell's usage of the term "Chemung" was in the traditional sense of most reports dealing with the Upper Devonian of western Pennsylvania wherein the name "Chemung" is used for the marine beds underlying the "Catskill" beds.

Charles Butts[7] concluded from faunal evidence that the uppermost Devonian rocks of the inliers are equivalent to the Conewango series of northwestern Pennsylvania. There was, however, still some doubt in his mind whether the Conewango should be placed in the Upper Devonian or the Lower Mississippian or should bridge the two. Girty[8] had interpreted the Conewango fauna as showing an intermingling of Upper Devonian and Lower Mississippian types. From his faunal studies, Girty had concluded that the Conewango and the immediately superjacent strata of the Cussewago stage in northwestern Pennsylvania constituted a Devono-Mississip-

[1] Caster, K. E., The Stratigraphy and Paleontology of Northwestern Pennsylvania, Part I Stratigraphy: Bull. Am. Paleontology, vol. 21, p. 1-185, 1934
Chadwick, G. H., The Great Catskill Delta: Pan-Am. Geologist, vol. LX, p. 91-107, 189-204, 275-286, 348-360, 1933.
Fettke, C. R., Bradford Oil Field, Pennsylvania and New York: Pennsylvania Geol. Survey, 4th ser. Bull. M 21, 1938.
Willard, Bradford, "Middle and Upper Devonian" in The Devonian of Pennsylvania: Pennsylvania Geol. Survey, 4th ser., Bull. G 19, 1939.

[2] Stevenson, J. J., Fayette and Westmoreland District, Part II, The Ligonier Valley: Pennsylvania 2d. Geol. Survey Report K 3, p. 54-60, 1877.

[3] Stevenson, J. J., The Upper Devonian Rocks of Southwestern Pennsylvania: Am. Jour. Sci., 3rd ser., vol. 15, no. 90, p. 423, 1878.

[4] Willard, Bradford, Chemung of Southwestern Pennsylvania: Pennsylvania Acad. Sci. Proc., vol. VII, p. 1-12, 1933.
Willard, Bradford, op. cit. Bull. G 19.

[5] Chadwick, G. H., What is "Pocono"?: Am. Jour. Sci., vol. XXIX, p. 133-143, 1935.

[6] Campbell, M. R., U. S. Geol. Survey Geol. Atlas, Masontown-Uniontown folio (no. 82), p. 6, 1902.

[7] Butts, Chas., Pre-Pennsylvanian Stratigraphy: Pennsylvania Topog. and Geol. Survey Comm., Rept. for 1906-1908, p. 190-204, 1908.

[8] Girty, George, Science, vol. 19, p. 24-25, 1904.

pian transition series for which he proposed the name "Bradfordian." It is only recently[9] that the Bradfordian series has been repudiated and apparently its ghost has not been laid to the satisfaction of all.

Bradford Willard[10] reopened the discussion of the age of the Devonian of southwestern Pennsylvania when he essentially reasserted Stevenson's conclusion that a fairly large unconformity exists between the Devonian and Mississippian and gave only a few amendments to the latter's generalized faunal list. Willard considered the exposed Devonian in the inliers as equivalent to the Cayuta formation (lower Chemung) of New York State. He reaffirms his views in his latest treatise[11] on the Devonian of Pennsylvania.

K. E. Caster[12] in the discussion with Willard stated his opinion, derived from faunal data, that the age of the exposed Devonian at Summit near the crest of Chestnut Ridge is Conewango. Both Caster and Butts based their decision on several diagnostic fossils which have never been determinitively reported outside the Conewango. These diagnostic forms do not appear on either Stevenson's or Willard's faunal lists. Chadwick,[13] on the basis of a literature survey, concluded that the age of the uppermost Devonian exposed in southwestern Pennsylvania is Canadaway.

In a preliminary report on Fayette County in 1937, F. T. Moyer[14] lists the Devonian exposed in the inliers in that county as "lower Chemung" with a footnote referring to Caster's and Willard's discussion referred to above. Although Moyer left the age of these beds unsettled it is evident from his sections and remarks elsewhere that he did not make a critieal faunal study and did not feel in a position to evaluate eonflicting opinions. He states that the "Chemung" beds are fossiliferous right up to the base of the "Pocono" on Chestnut Ridge, and that on Laurel Hill, "the Chemung is separated from the Pocono by the Catskill series."

The status of the Devonian stratigraphy of Fayette County is reviewed by Dr. Ashley[15] in a recently issued report. The writer is not in agreement with many of the observations in this volume concerning the Upper Devonian and Lower Mississippian stratigraphy. It is evident that the faeieologic nature of the Upper Devonian deposits was not seriously eonsidered when this report was written. Without considering the facies concept, these Upper Devonian deposits will remain forever a mystery. However, the fact that the presence of Upper Devonian marine beds later than lower Chemung in southwestern Pennsylvania is recognized is a distinct advance in the sub-Carboniferous stratigraphy of this area.

Willard[16] states that in the Conemaugh gorge through Laurel Hill near Johnstown the "Pocono" rests direetly on red beds on the east limb of the anticline while on the west limb the "Pocono" rests upon a brown sandstone eontaining a very meagre fauna which he concluded was an equivalent of the "lower Chemung" section at Summit, Fayette County. In his 1939 monograph on the Devonian, Willard reemphasizes this pinching out to zero of the red beds below the "Pocono" on the west limb of the Laurel Hill antieline.[17] Dr. G. H. Ashley (*litt.* October 13, 1939) states that he has per-

[9] Caster, K. E., Torrey, P.D., Chadwick, G. H., Demise of the "Bradfordian Series": Am. Assoc. Petroleum Geologists Bull. vol. 19, p. 912-915, 1935.

[10] Willard, B., Caster, K. E., Age of Devonian of Southwestern Pennsylvania: Am. Assoc. Petroleum Geologists Bull. vol. 19, p. 1546-1550, 1935.

[11] Willard, B., "Middle and Upper Devonian" in The Devonian of Pennsylvania: Pennsylvania Geol. Survey, 4th ser., Bull. G 19, p. 250, 1939.

[12] *Idem.*

[13] Chadwick, G. H., What is "Pocono"?: Am. Jour. Sci., vol. XXIX, p. 142, 1935.

[14] Moyer, F. T., Structure and Stratigraphy of Fayette County (Prelim. Report): Pennsylvania Topog. and Geol. Survey, Bull. 115, p. 16, 1937.

[15] Hickok IV, W. O., and Moyer, F. T., Geology and Mineral Resources of Fayette County, Pennsylvania: Pennsylvania Geol. Survey Bull. C 26, 530 pp., 1940.

[16] Willard, Bradford, op. cit., Bull. G 19, p. 260.

[17] K. E. Caster has recently reviewed Willard's treatise on "The Devonian of Pennsylvania." This review should be referred to in order to evaluate properly Willard's contribution. See, Caster, K. E., Jour. Paleontology, vol. 14, p. 605-610, 1940.

sonally investigated this section and has found that the red beds do not pinch out to zero on the west limb but that everything is normal and that the red beds descend below the "Pocono" on both sides of the arch. This observation is in accord with detailed observations made by the writer during the field seasons of 1939 and 1940. Faunal studies, however, indicate that there are several feet of Lower Mississippian and Upper Devonian fossiliferous strata between the base of the barren part of the "Pocono" and the top of the Devonian red beds.

UPPER DEVONIAN FACIES RELATIONSHIPS

The facieologic aspect of the Upper Devonian deposits of Pennsylvania has been reported at some length by Caster,[18] Chadwick,[19] and Willard.[20] Only a passing reference is made here. In general, it is well known that from at least Middle Devonian time to the end of the period there was a relatively steady westward encroachment of continental conditions with only temporary eastward marine encroachments. Caster's and the writer's studies have indicated that at the close of the Devonian there occurred a minor eastward progression of marine conditions which was carried on with but slight, if any, interruption into Lower Mississippian time.

Concentric about this ever-westward-encroaching shoreline of the Upper Devonian sea were various ecologic belts of varied lithology and faunal content. Seven such facies (*magnafacies*) have been delimited by Caster, five of which Chadwick also recognizes.*

In the inliers of southwestern Pennsylvania, two such magnafacies with parts of two others can be seen. The main magnafacies of marine origin is a sequence which is dominantly sandstone below with some interbedded shale, while the upper part consists primarily of shale. As the lower sandy portion is being correlated with the Conneaut stage and as the upper shale portion is being correlated with the Venango and Riceville stages, this marine magnafacies can be subdivided into two *parvafacies*. Caster has termed a parvafacies that part of a magnafacies lying between two lines of contemporaneity. This southwestern Pennsylvania marine magnafacies is being correlated with the Big Bend magnafacies of northwestern Pennsylvania.

Tonguing into this marine magnafacies from the east, northeast, and southeast is a red sandstone and shale sequence apparently mainly nonmarine in origin. This tongue is inserted into the marine magnafacies approximately at the boundary between the sandstone sequence below and the shale sequence above. However, it apparently displaces the overlying shale sequence more rapidly than the underlying sandstone strata. This red tongue is a westward extension of the Catskill continental magnafacies next eastward from the Big Bend magnafacies. Normally the Smethport magnafacies would intervene between these two but it apparently is represented in this area by only a few feet of fossiliferous strata at the base of the reds. Tonguing into the Big Bend magnafacies from the west are a few feet of dark-grey shale which have the appearance of the Chagrin magnafacies. The Chagrin magnafacies is the next westward magnafacies to the Big Bend magnafacies. The inliers of southwestern Pennsylvania are too far to the east for the Chagrin magnafacies to be very well developed.

[18] Caster, K. E., The Stratigraphy and Paleontology of Northwestern Pennsylvania, Part I Stratigraphy: Bull. Am. Paleontology, vol. 21, p. 1-185, 1934.

[19] Chadwick, G. H., The Great Catskill Delta: Pan-Am. Geol., vol. LX, p. 91-107, 189-204, 275-286, 348-360, 1933.

[20] Willard, B., op. cit., Bull. G 19.

* Laird shows that certain beds contain similar fossils and therefore appear to belong to the same ecological belts as the Cussewago group in Erie and Crawford Counties. Other beds have fossils similar to those of the Riceville and Venango formations of northwestern Pennsylvania. While the presence of similar fossils is certainly interesting, it by no means proves that the Fayette County strata are either stratigraphically or temporally equivalent to beds containing similar fossils 150 miles northwest. "Precise correlation" must await the study of good well logs in the intervening area. P. A. Dickey.

DETAILED STRATIGRAPHY

Preliminary Statement and General Correlations

The stratigraphic conclusion reached in the impartial restudy of all available data is that the Upper Devonian sequence of southwestern Pennsylvania is most similar in faunal content and lithology to the Conewango series of northwestern Pennsylvania and should be correlated with that sequence. It also seems likely that the upper part of the Conneaut stage may also be present in the deepest of the inlier sections but more detailed faunal studies of the rather unsatisfactory fossil materials must be made before this can be definitely determined. The Riceville (Oswayo) stage which overlies the Conewango in the northwest has not been positively identified but certain of the beds have enough faunal similarity to the Riceville that a tentative correlation seems warranted. Thus the hiatus between the Devonian and the Mississippian in the inlier area has been narrowed down to the same proportions as that in northwestern Pennsylvania where it has often been mistaken for a transition.

As a result of the present work fossiliferous beds have been delimited for the first time from the base of the "Pocono." These beds have been found to agree faunally and lithologically with the beds included in the Cussewago stage of the Oil Lake series (Mississippian) of northwestern Pennsylvania.

TABLE I

Stratigraphic units of the Lower Mississippian and the Upper Devonian of southwestern Pennsylvania

MISSISSIPPIAN SYSTEM
- Kinderhook series
  - Shenango and Meadville stages (?)
    - Sandstone J
- Oil Lake series
  - Berea stage
    - Conglomerate I
  - Cussewago stage
    - Sandstone H
    - Sandstone G
    - Sandstone E and Conglomerate F

DEVONIAN SYSTEM
- Conewango series
  - Riceville stage (?)
    - Sandstone D
  - Venango stage
    - Shale C
    - Sandstone B
- Chautauquan series
  - Conneaut (Chadokoin) stage (?)
    - Sandstone A

In order to give a general picture of the stratigraphic sequence of the Devonian and Mississippian of the inliers, Table II giving the section exposed in the deepest inlier has been prepared.

TABLE II

Stratigraphic section exposed in the Youghiogheny gorge through Laurel Hill

	Ft.	in.
Mississippian system		
Kinderhook series		
Shenango and Meadville stages (?)		
71. **Sandstone J.** Massive, cross-bedded sandstones and interbedded shales. Unfossilferous except for macerated plant remains. Weathers from a grey-brown to a rusty-brown color. Makes cliffs along Rock Spring Run north of Victoria, known locally as the Mary Day cliffs. These sandstones are much thinner here than in the other inliers, probably because of a large disconformity at the top	142	
Oil Lake series		
Berea stage		
70. **Conglomerate I.** Type locality is along Rock Spring Run north of Victoria. Massive, cross-bedded, grey, flat quartz-pebble conglomerate. The long dimension of the pebbles is usually aligned with the bedding or cross-bedding planes. The conglomerate is thicker on the south bank of the Youghiogheny River than on the north bank	20-28	
Cussewago stage		
Sandstone H		
69. Concealed. This covered interval was measured on the south bank of Youghiogheny River and tied in with a better section exposed along the Baltimore & Ohio Railroad on the north bank. Some discrepancies might result from this procedure	35	
68. Massive, green-grey, micaceous sandstone. Cross-bedded, weathering rusty brown with the suggestion of fossil fragments. Fossils actually found include *Leptodesma, Syringothyris,* and crinoid stems	12	
67. Concealed	3	6
66. Grey-green sandstone weathering brownish black. Suggestion of fossils	3	6
65. Concealed	3	
64. Thin-bedded sandstone with shale at the bottom. Weathers rusty brown with the suggestion of fossils	4	8
63. Grey-green to brown, shaley sandstone with more shale toward the bottom, and thicker beds of sandstone toward the top	3	
62. Ripple-marked, grey-green sandstone weathering to a brownish black	1	
61. Grey, sandy shale weathering rusty brown	3	
60. Massive, grey-green to brown, micaceous sandstone. Has two beds containing small cross-bedding. Weathers rusty brown	6	
Sandstone G		
59. Grey, thin-bedded shale weathering whitish, interbedded with grey-brown sandstone	2	6
58. Brown-grey, cross-bedded sandstone tending to color red on weathering. Becomes thin-bedded and weathers whitish toward the top where it is a little shalier	5	6
57. Grey shale badly weathered to white	3	
56. Irregularly cross-bedded, brown-grey sandstone. Very few invertebrate fossil fragments. Surface of bedding planes ripple-marked and covered with worm burrows	6	
55. Grey shale	3	
54. Irregularly-bedded, grey-brown sandstone	5	6
53. Thin-bedded, grey shale weathering dirty white	3	
52. Sandy, brown-grey shale. Partly covered	4	
51. Thin, irregularly-bedded, grey shale weathering dirty white. Worm burrows abundant. *Eumetria scansa* only fossil well preserved. Fragments of *Bradfordoceras, Camarotoechia, Athyris* cf. *angelica,* and a *Palæoneilo* sp. have come from near or at this horizon	8	
Sandstone E		
50. Brownish grey, noticeably cross-bedded, calcite-cemented sandstone. Weathers to a soft, friable rusty-brown sandstone. Invertebrate fossils are found only as fragments. This is the stratigraphic interval of Sandstone E although not its type locality	2-5	6
Total for Sandstone E, G, H	120	8

TABLE II—Continued

Unconformity

Devonian system

Conewango series

Riceville and Venango stages

Sandstone D and Shale C

The section is continued on the south bank of the Youghiogheny River along the Western Maryland Railroad.

		Feet
49.	Blue-grey, micaceous, interbedded sandstone and shale	12
48.	Blue, irregularly-bedded sandstone. Marks the beginning of a cliff	12
47.	Grey sandstone and shale	12
46.	Rather massive, grey-brown sandstone. Bottom part the most massive, making cliff	18
45.	Grey, slightly sandy, thin-bedded shale. Weathers to elongated fragments resembling pencils	4
44.	Grey-brown sandstone	4
43.	Grey, thin-bedded shale	6
42.	Grey, almost white, quartzitic sandstone containing a few plant fragments. Makes a cliff	14½
41.	Interbedded sandstone and sandy shale. Very sparsely fossiliferous	30
40.	Concealed. No red beds apparent in this interval	159½
	Total for Sandstone D and Shale C	272

Sandstone B

39.	Green-grey to red, rather massive sandstone. Cross-bedded and weathers to thin plates in place. Slightly shaley with interbedded red shale and sandstone toward the top	72
38.	Concealed	54
37.	Thin-bedded, grey-green and red shale weathering rusty. Small fold in this member	12
36.	Grey-green sandstone weathering rusty. Some interbedded shale. Some of the sandstone is red changing laterally to green	18½
35.	Green sandstone interbedded with green and red shale. This is a zone of locally severe eastward thrusting which makes measurements here unreliable. The rapid lateral change from red to green and vice versa makes the tracing of individual members across the faulted zone difficult	48
34.	Thin-bedded, grey, limy shale with cross-bedded sandstone lenses. The sandstone is more prominent toward the top of the member	16±
	Disconformity	
33.	Rather massive, cross-bedded, grey sandstone with some interbedded shale	18
32.	Cover and red sandstone	20
	Disconformity	
31.	Very bright, brick-red shale with some interbedded thin sandstone toward the middle of the member. Many green spots and streaks through the shale	20
	Disconformity	
30.	Rather massive, yet platey, red and green sandstone. Brown cross-bedded sandstone at the bottom	12
	Disconformity	
29.	Greenish shale and sandstone with some sandstone lenses. Some interbedded red shale	18
28.	Red to green platey sandstone containing some clay galls. Ripple cross-bedding noted	7
27.	Thin-bedded red shale with green streaks	6½
26.	Massive grey sandstone weathering red. Channel fillings on bottom surface	3
25.	Red shale with thin-bedded red sandstone 1 to 6 inches thick interbedded. Some of the red shale quite massive. Green shale bed near the top of the member	26
	Disconformity	
24.	Massive, cross-bedded green-grey sandstone weathering red. Several disconformities within the member. *Ptychopteria sp.* and plant fragments in the bottom of the bed	24
23.	Rather thin-bedded red shale and sandstone interbedded with some green shale. Very micaceous. This bed on the north bank of the river contains a poorly preserved but abundant cephalopod and pelecypod fauna	47
	Total for Sandstone B	422

TABLE II—Continued

The section now continues along the north bank of the river east of Victoria along the Baltimore & Ohio tracks.

Chautauquan series

Conneaut stage (?)

Sandstone A

		Feet
22.	Thin-bedded green shale	11
21.	Massive, green-grey, micaceous sandstone weathering to a rusty color. Contains layers of clay-gall conglomerate with some grey, sandy shale interbedded. Few fossils. Makes almost vertical cliff	22
20.	Mainly grey, thin-bedded shale with some few interbedded sandstone layers. Few round quartz pebbles present, and layers of limonitic concretions. Worm burrows and spheroidal weathering noticeable	41
19.	Massive, green-grey, micaceous sandstone containing some clay galls	4
18.	Grey-green, thin-bedded shale weathering rusty	6
17.	Grey-green, micaceous sandstone tending to show cross bedding. Ironstone concretions. The fossils in this member are preserved as internal and external molds covered with dark limonitic stain. *Schizodus* very abundant	6
16.	Green sandstone growing shaley and more thin-bedded toward the top	19
15.	Grey-green, fairly coarse-grained, massive sandstone containing clay galls. Sandstone tends to fracture conchoidally. Suggestions of vertical worm tubes. Weathers rusty brown	21¼
14.	Concealed	4
13.	Massive, grey, quartz-pebble conglomerate tending to be more thin-bedded toward the top. Quartz pebbles are about of pea size and tend to be oriented along the bedding planes	6
12.	Massive, thin-bedded, grey, sandy, micaceous shale. Makes a cliff. Tends to weather brown. The shale has a slightly laminated appearance with ripple cross-bedding indistinctly developed. Sandstone layer 2 feet thick near the base	15
11.	Coarse, grey sandstone containing an occasional quartz pebble the size of a pea. Some clay galls also present. Cross-bedding and many disconformities present in the member. Sandstone tends to grade upward into the overlying shale	8
10.	Concealed with shale and sandstone blocks	61
9.	Grey-green to brown, micaceous sandstone weathering rusty	5
8.	Concealed	27
7.	Reddish-grey sandstone with layers of reddish shale. Weathers rusty on joint planes. Exposed	6
6.	Concealed and green-brown shale	3±
5.	Reddish, rusty-colored shale with carbonaceous films on some weathered surfaces. Some red shale mud chips or clay galls present	2±
4.	Massive, mottled, grey sandstone; more massive toward the bottom, less so at the top. Contains macerated plant fragments	22
3.	Concealed	85
2.	Coarse, grey-white sandstone interbedded with quartz-pebble and clay gall conglomerate. *Camarotoechia, Leptodesma,* and *Ptychopteria* (?) found	8
1.	Grey, thin-bedded shale weathering rusty	4
	Total for Sandstone A	386¼

Devonian System

CHAUTAUQUAN SERIES

Conneaut (Chadakoin) stage (?)

*Sandstone A.** The member (or parvafacies) called Sandstone A consists of sandstones with a few interbedded shales. Both the sandstones and the shales tend to be micaceous, as do most of the sediments of the Devonian and Mississippian of these inliers. The sandstones are often coarse-grained,

* When a more definitive study of this area is published, it is probable that this member will be named the Maple Summit sandstone.

and lenses of conglomerate containing both quartz pebbles and clay galls are not uncommon.** Several instances of channel-fillings on the bottom of sandstone layers were noticed. In comparison with the Shale C, Sandstone A is much coarser grained and contains fewer well-preserved fossils. Sandstone A is 386 feet thick in the Youghiogheny gorge through Laurel Hill, the only inlier where it is exposed.

As has been stated the faunal content of this member is meagre. Many fossil fragments are found but well-preserved fossils are few. Only one bed was found that contains a readily identifiable fauna. The faunal list (Table III) accompanying this report gives the names of the forms found in this sandstone. The most abundant and characteristic fossils of this member are *Schizodus* aff. *chemungensis* (Conrad) and *Palaeanatina solenoides* Hall. These forms occur in none of the other members exposed in the inliers. Numerous *Schizodus* and the type of Devonian shell usually assigned to *Elymella* are abundant in the red beds immediately overlying Sandstone A but *Palaeanatina solenoides* Hall is absent there. *Pteronites* cf. *profundus* Hall is also found in this sandstone but at no other horizon in the region. This form is reported by Chadwick[21] from above and below the Conewango but never from it. On the basis of Chadwick's faunal lists it would appear that this fauna is a combination of Conewango and pre-Conewango forms. However, the presence of *Pteronites*, certain forms of *Schizodus*, and the fact that *Palaeanatina* is not found above would seem to indicate a Conneaut age for this member.

At best, the faunal evidence for the inclusion of these beds in the Conneaut is none too good. However, both the fauna and the lithology are considerably different from the beds included in the overlying Conewango. If it should be proved by more exhaustive collecting that these forms really belong in the Conewango, the increase in thickness of the Conewango in southwestern Pennsylvania to 1,079 feet from about 500 feet in northwestern Pennsylvania would be interesting to note.

The upper contact of Sandstone A beds with the overlying Sandstone B is sharp and apparently conformable. It is true, however, that there are several non-red beds above the base of the reds. These non-red beds probably represent advances of more marine conditions into areas of continental or brackish water deposition. Such is the nature of a facies plane contact, as Caster (1934) and others have shown. The base of the Sandstone A has not been seen in the inliers.

The type exposure of Sandstone A is found along the cuts of the Baltimore & Ohio Railroad about one mile west of Bidwell.

CONEWANGO SERIES

Venango stage

*Sandstone B.** Sandstone B consists of red sandstone and interbedded shale and is a normal expression of the Catskill magnafacies, being made up of a series of alternating red sandstones and bright brick-red shales interbedded with some massive, green sandstones and green shales. Along fracture planes and around some of the plant fragments in the red shales, downward-percolating water has had a reducing effect upon the red shales, changing them from a ferric (red) state to a ferrous (green) state and giving the shales a streaked appearance.

The red sandstones and shales also show a rapid lateral color change from red to green. This change, which can be demonstrated locally to take place within a distance of 3 or 4 feet, is disconcerting when trying to trace

** In this paper, the term clay gall is used to indicate small chips or pieces of shale or mud 1 to 2 inches in diameter which are incorporated in a sandstone or conglomerate.

[21] Chadwick, G. H., Faunal differentiation in the Upper Devonian: Geol. Soc. America Bull., vol. 46, p. 305-342, 1935.

* When a more definitive study of this area is published, it is probable that this member will be named the Youghiogheny sandstone.

beds across the faulted section that is found in the best development of the red sequence in the inliers.

The Sandstone B member is 422 feet thick in the Youghiogheny gorge through Laurel Hill. It does not crop out extensively farther west but is clearly represented in the well logs for the Summit gas pool. In the Heyn no. 1 well at Summit the Sandstone B red beds are 400 feet thick. The member does not crop out in the Youghiogheny gorge through Chestnut Ridge except for about 10 feet of strata that are exposed by a fault of apparently small displacement, indicating that the reds are not far below the surface there.

Most of the red beds are unfossiliferous except for the few plant fragments already mentioned. A rather abundant marine fauna is preserved in a red sandstone near the base of the member. This consists of a few poorly preserved pelecypods and cephalopods. The most abundant fossil is reminiscent of Conewango pelecypods referred with doubt by Caster[22] to *Elymella*. At least three species of this mollusc are present, only one of which bears affinities to species already described. The Brachiopoda are represented by a single linguloid form which is relatively rare. In facieologic setting this fauna broadly corresponds to Caster's[23] Lewis Run sandstone fauna (Hanley sandstone of Fettke[24]) of northwestern Pennsylvania, As mentioned under the Sandstone A discussion, this marine fauna of Sandstone B has a slight resemblance to that of the underlying Sandstone A member but the predominant faunal elements of the red sandstone (B) are Conewangoan. This basal Sandstone B fauna has been included under the heading of the Shale C fauna in the biotic list as the Sandstone B reds replace some of the basal Shale C beds when the latter are traced from the Summit inlier to the Youghiogheny gorge through Laurel Hill.

These red beds replace both the overlying Shale C beds of the Conewango and the underlying beds of the Conneaut if traced eastward to the Allegheny Front, where the highest non-red fossiliferous strata are true Chemung in age. The Sandstone B red beds are a tongue-like extension of the Catskill magnafacies into a marine magnafacies which is represented by Shale C and Sandstone A members. It seems possible that the basal part of the reds which contains the marine fauna could, with some reason, be assigned to the Smethport magnafacies, which is intermediate between the Catskill and the Big Bend magnafacies in northwestern Pennsylvania. However, this magnafacies is so evanescent that it is thought best to include it under the Catskill magnafacies. Such dimunition of magnafacies belts is apparently not uncommon.

An interesting structural feature of the inlier region occurs in the best exposure of the Sandstone B red beds in the Laurel Hill gorge. A locally-severe, westward-dipping thrust fault zone is represented by at least three thrust planes in the red strata. Owing to the already-mentioned difficulty in tracing these beds across the faulted section, any thickness given for the entire section or any estimate of stratigraphic displacement in the fault zone would likely be inaccurate. However, from present evidence, it seems reasonable that at least 35 to 40 feet of stratigraphic displacement is involved in this faulting.

The sharp contact of the Sandstone B red beds with the underlying Sandstone A has been described. The contact with the overlying Shale C beds is apparently slightly more gradational. Fossils found in non-red beds near the top of the Sandstone B red beds indicate that the facies plane here is somewhat less regular than the lower facies contact of the reds with Sandstone A.

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[22] Caster, K. E., Higher fossil faunas of the Upper Allegheny: Bull. Am. Paleontology, vol. 15, p. 88, 1930.

[23] Caster, K. E., The Stratigraphy and Paleontology of northwestern Pennsylvania, Part I Stratigraphy: Bull. Am. Paleontology, vol. 21, p. 25, 1934.

[24] Fettke, C. R., Bradford Oil Field, Pennsylvania and New York: Pennsylvania Geol. Survey, 4th ser., Bull. M 21, p. 37, 1938.

It should be understood that, as these beds replace the overlying and underlying beds to the northeast, east, and southeast, this term, Sandstone B, has only local application as a parvafacies expression.

The type exposure of Sandstone B is along the tracks of the Western Maryland Railroad on the south bank of the Youghiogheny River opposite the settlement of Victoria.

*Shale C.** Shale C consists of grey, thin-bedded shales with interbedded, grey, limy sandstones and some clay-gall conglomerates. Some of the shale toward the bottom of the exposure at Summit has a blue-black color which would suggest a temporary eastward advance or a local independent development of the Chagrin magnafacies. The sandstones are lenticular and so local are some of them that they suggest the possibility of channel fillings. The shale does not appear to undergo much change of color upon weathering but the grey sandstones weather to a limonitic brown.

The most common fossils are *Camarotoechia sappho* Hall, a congener of "*Spirifer*" *disjunctus* bearing fine ribs on the median sinus and fold after the manner of the manuscript *S. carrensis* Caster from the Conewango of the northwestern part of the State, and *Ncocycloceras obliquum* Flower and Caster. The undescribed congener of "*Spirifer*" *disjunctus* is by far the most abundant member of the whole fauna and comprises a large number of the specimens collected. The best fossils of Shale C come from the interbedded sandstones. The fauna of the fissile shales is probably as abundant as that of the sandstones but is not readily collected or identified.

Shale C beds are 181 feet thick in the type section, along the National Pike, half way up the west side of Chestnut Ridge at the Summit inlier; nearer the foot of the ridge only 137 feet is exposed. In the Youghiogheny gorge through Chestnut Ridge southeast of Connellsville, the Shale C beds are also exposed. In this section, from what appears to be the base of Sandstone D to the base of the Shale C member is 406 feet. Most of this is, however, covered interval and therefore subject to error. The covered interval was paced several times and the average taken. The thickness of the beds was then computed trigonometrically. It must also be said that there is a possibility of faulting in this interval, which would tend to make the thickness computation unreliable. It is also a likely possibility that the section of the Shale C member in the Youghiogheny gorge through Chestnut Ridge is somewhat thicker.

Shale C in Laurel Hill retains its typical characteristics but is somewhat thinner and much less fossiliferous.

These beds and the overlying Sandstone D and interbedded shales are very similar faunally except that the preservation of the fossils is much better in the latter member. Together these beds can be traced in all the inliers as far northeast as Johnstown but on the Allegheny Front the red beds have entirely replaced the marine Conewango sequence.

The gradational contact of Shale C and Sandstone B has been noted. The contact with the overlying Sandstone D is sharp but apparently conformable.

The type section of Shale C is along the National Pike about 2¼ miles east of the town of Hopwood. The section is best exposed in the cuts above and below the Watering Trough Inn and Spring.

Riceville stage

Sandstone D.† Sandstone D consists of 135-152 feet of interbedded grey-brown sandstones and shales with some lenses of white quartz-pebble and clay-gall conglomerate. It is definitely more sandy than the underlying

* When a more definitive study of this area is published, it is probable that this member will be named the Watering Trough shale.

† When a more definitive study of this area is published, it is probable that this member will be named the Jumonville sandstone.

Shale C. This member carries most of the Devonian fossils usually reported from the inlier area as it is the only horizon at which fossils are locally abundant and well preserved.

The "*Spirifer*" *disjunctus* congener ("*warrenensis*" Caster ms.), *Camarotoechia sappho* Hall and *Aviculopecten patulus* Hall are the most abundant species present; *Pararca* and *Ptychopteria* are rarer indices of first importance. Details of the fauna are shown on the biotic chart. This fauna is rather reminiscent of the Oswayo fauna of northwestern Pennsylvania but since only one specimen of *Camarotoechia* cf. *alleghania* Williams has been tentatively identified from Sandstone D, precise correlation seems unwarranted at this time. Certainly if Sandstone D is a correlate of the Oswayo it represents a somewhat different facieologic setting. In the type area, the Oswayo is a limonitic and micaceous shale and sandstone with occasional coquinite zones of clearly lagoonal origin near the shore. Sandstone D on the other hand apparently represents a more seaward zone where the sorting by wave action apparently was better.

It seems reasonable to assume from faunal as well as stratigraphic evidence that this member is equivalent to the uppermost fossiliferous Devonian in the Conemaugh gorge through Laurel Hill at Johnstown and in the Conemaugh gorge through Chestnut Ridge east of Torrance. The lithology of the last two places suggests Sandstone D and, since the fauna is very sparse and the thickness has increased considerably to 215-236 feet, it is possible that the upper part of Shale C has been included in the measurements. Perhaps the Sandstone D member grades into the massive grey sandstones in the top of the "Catskill" reds on the Allegheny Front, which Willard [25] has recently suggested may be of Oswayo age, but proof is still lacking.

The contact of Sandstone D with the Shale C is apparently conformable, whereas the contact with the Mississippian beds above is clearly disconformable.

The type locality of Sandstone D is along the National Pike at the Watering Trough Inn below the crest of Chestnut Ridge, where the best fossils can be collected. A longer section of the member is exposed in the Youghiogheny gorge through Chestnut Ridge in the vicinty of the mouth of Indian Creek but the fossils are not as abundant there.

Mississippian System

OIL LAKE SERIES

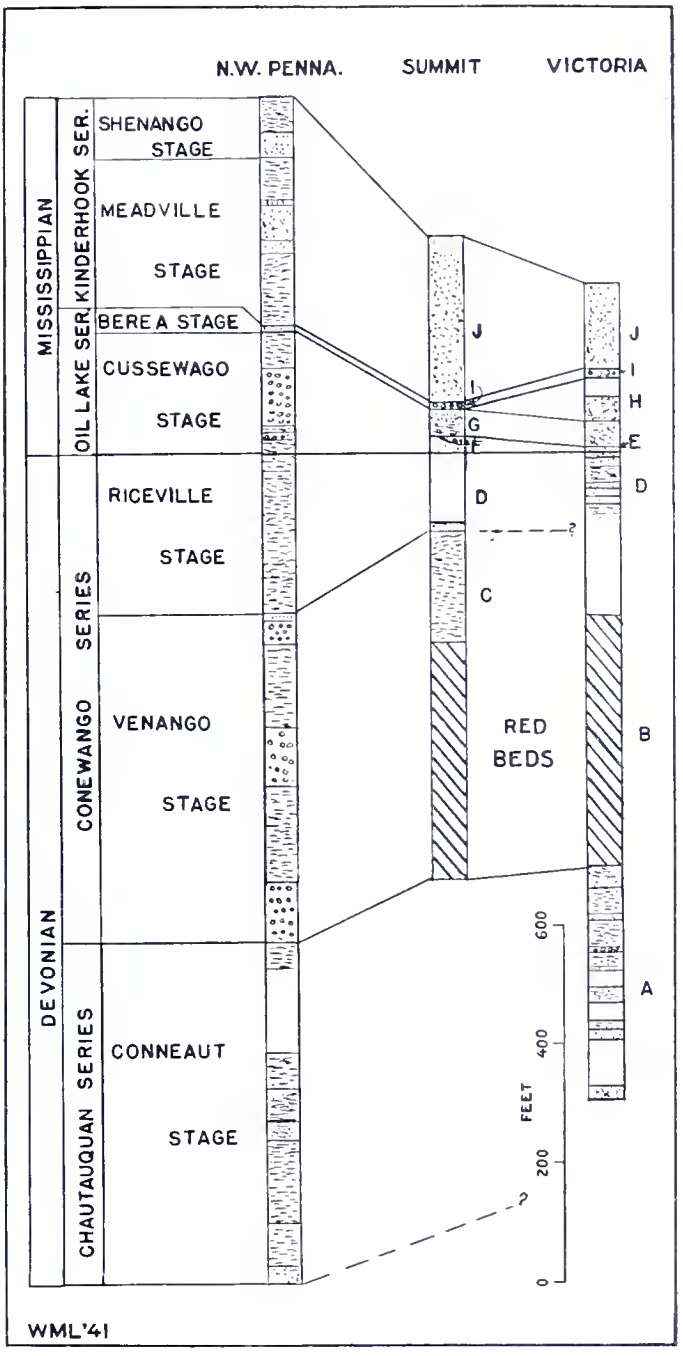
Cussewago stage

*Sandstone E.** Sandstone E is the basal member of the Mississippian system in the inliers. It consists of 2½ to 5 feet of sandstone principally cemented with calcite. The lime content of the sandstone weathers readily so that the usual appearance of the member is a friable, limonitic sandstone occasionally replete with the molds of fossils.

The fauna of Sandstone E is the most outstanding fauna of the whole area as it is particularly characterized by the abundant individuals of very large *Leptodesma* and *Mytilarca*. While these forms in themselves are not definitive criteria of a Mississippian age, their associates *Eumetria scansa* (Hall) and *Syringothyris* cf. *angulata* Simpson leave little doubt of the Mississippian age of the sandstone. *Leptodesma* is represented by the large types characterizing Caster's "Devil's Den" or Knapp fauna of northwestern Pennsylvania. Essentially this same fauna with somewhat smaller shells and fewer species carries on into the overlying Sandstone G, where certain faunal augmentations are the chief indices for differentiation.

[25] Willard, B. "The Middle and Upper Devonian" in The Devonian of Pennsylvania: Pennsylvania Geol. Survey, 4th ser., Bull. G 19, p. 302, 1939.

* When a more definitive study of this area is published, it is probable that this member will be named the Linderman sandstone.



Correlation of geologic sections.

The relationship of these two members is much closer than that between Sandstone E and the underlying Sandstone D.

The contact of Sandstone E with the underlying Sandstone D can be demonstrated to be a low angular unconformity in one locality and a disconformity in others. The contact with the overlying Sandstone G is appar-

ently conformable, the differences in fauna being the main distinction between the two members.

Although the sandstone is present in all the inliers it is best exposed for study in three places: (1) The west limb of the Chestnut Ridge anticline in the Youghiogheny gorge southeast of Connellsville; (2) the type locality, on the Linderman farm, in the Youghiogheny gorge through Laurel Hill near Victoria; (3) Route 40 just west of and below the Summit Hotel at the highway lookout.

*Conglomerate F.** In the Summit section over Route 40 in the vicinity of the highway lookout below Summit Hotel, the basal fossiliferous Sandstone E has not been found. In what is its apparent stratigraphic position, an unusual sandstone and conglomerate member occurs which is being termed Conglomerate F in this report.

The Conglomerate F member consists of two parts, a lower, massive, cliff-making, brown-grey sandstone 15-20 feet thick; and an upper conglomerate member ranging up to 8 feet in thickness. The conglomerate is lenticular and lies in unconformable relationship with the sandstone and a thin interbedded shale. It is also disconformable with the overlying Sandstone G.

White vein-quartz pebbles of pea-size or slightly larger imbedded in a matrix of coarse, greenish-grey sandstone comprise the conglomerate. The quartz pebbles decrease to wheat-size toward the top of the conglomerate. Some jasper pebbles 1 to 2 inches in diameter are also present.

The most intersting feature of the conglomerate is its unusual appearance near its base. In this zone, the conglomerate is contorted into large, boulder-like masses as much as 6 or more feet in diameter. Where the conglomerate rests on the underlying grey shale the shale has been forced up into the crevices between the masses of contorted conglomerate. Where the masses rest upon one another the matrix is the same material as the boulder-like masses themselves.

There are two possible explanations for the cause of this phenomenon, both of which causes were no doubt operative at various times during the formation of this deposit. First, it seems likely that this deposit may have formed on a fairly steep submarine slope, from which it slid. During the sliding, the conglomerate was kneaded into the present boulder-like masses. When this conglomerate mass came to rest upon the shale the weight of the large masses caused a differential movement or an interstratal flowage during which some of the shale was forced into the crevices between the boulder-like masses. Thus it would appear that the main explanation for the peculiar nature of this deposit is submarine sliding with differential movement between two of the members as a subsidiary process. This is apparently the same type of phenomenon that Chadwick[26] has termed "storm rollers."

The lower contact of the Conglomerate F member cannot be seen. The upper contact with Sandstone G is sharp but apparently conformable.

The type section of Conglomerate F is the cliff at the highway scenic lookout about one-quarter mile below the Summit Hotel on Route 40 east of Hopwood.

Sandstone G.† Overlying Sandstone E and Conglomerate F is a sandstone and shale sequence which is being termed Sandstone G. At the type locality along the National Pike at the highway lookout below Summit Hotel, the member is shaley for about 4 or 5 feet at bottom, grading upward with

* When a more definitive study of this area is published, it is probable that this member will be named the Hopwood conglomerate.

[26] Chadwick, G. H., Storm rollers: Geol. Soc. America Bull., vol. 42, no. 1, p. 242, 1931.

† When a more definitive study of this area is published, it is probable that this member will be named the Pine Knob sandstone.

slight unconformity into a grey-brown sandstone. The member is, as a whole, thin-bedded and indistinctly ripple-marked. In the type locality, the member is 42 feet thick. It retains about this same thickness eastward to Laurel Hill where it is 35-40 feet thick. In the Youghiogheny gorge through Chestnut Ridge the member measures about 75 feet in thickness.

Both sandstone and shale are fossiliferous but the sandstone provides a better medium for preservation. The fauna of Sandstone G is second to the Sandstone E member in the number of species. As was brought out previously, the Sandstone G fauna is similar in many respects to that of the underlying Sandstone E, but it contains several new forms, notably the gastropod *Igocerus* and certain forms of the pelecypods *Edmondia* and *Palaeoneilo*. *Igoceras* is the most important addition, for this genus suggests the relationship of Sandstone G with the *Igoceras*-bearing Tidioute shale of northwestern Pennsylvania. A distinct but rare variant of "*Spirifer*" *disjunctus* is also noted in this fauna.

The correlation of these members with similar divisions elsewhere in Pennsylvania is extremely difficult due to the undescribed nature of the faunas concerned. Not only does this fauna suggest a correlation with the Tidioute shale but the overlying Sandstone H suggests a correlation with the Kushequa shale of northwestern Pennsylvania which is supposed to underlie the Tidioute shale in that area. The correlations discussed under Sandstone H will bring out the possible relationship between these two areas more clearly.

The lower contact of the Sandstone G member with Sandstone E or its equivalent Conglomerate F has already been noted as conformable. The contact of the member with the overlying Sandstone H is apparently a disconformity of some magnitude.

The recognition of this fauna is important for it provides the key to the conspicuous fault on Route 40 near Milepost 50.

The type section of Sandstone G is in the highway cut at the scenic lookout below Summit Hotel on Route 40 east of Hopwood.

*Sandstone H.** Unconformably overlying Sandstone G is an extremely fossiliferous, grey-brown, quartzose sandstone which weathers from a light grey to a brown. In the type locality on Rock Spring Run north of Victoria, Sandstone H is about 35-40 feet thick but in other places, as at the highway lookout below Summit Hotel, it is absent entirely. While it is not often found exactly in place, it furnishes abundant talus to the hillsides below its outcrop. These talus blocks have been much used in the construction of stone fences and these latter today provide the best places for collecting fossils.

Although the number of species in this sandstone is small, it makes up for this lack in the large number of individuals of certain species, such as *Rhipodomella* cf. *huntingdonensis* Girty, *Cypricardinia* aff. *consimilis* Hall, *Palaeoneilo concentricus* Winchell, *Bradfordoceras* (?) sp. and Pteropods. *Syringothyris* cf. *angulata* Simpson is also present but is not as abundant as the above-mentioned forms.

The correlation of this member is indeed a problem. The finding of *Rhipodomella* cf. *huntingdonensis* Girty, *Palaeoneilo concentricus* Winchell, and *Cypricardinia* aff. *consimilis* Hall certainly suggests a close relationship to the Riddlesburg shale, as can be seen from the faunal list. The Riddlesburg shale, which is outside the scope of this paper, shows closest affinities faunally to the Kushequa shale of northwestern Pennsylvania, reported as lowest Mississippian (Knapp) in age. The Riddlesburg shale is really the connecting link between northwestern and southwestern Pennsylvania although somewhat out of the way geographically. The faunal evidence at

* When a more definitive study of this area is published, it is probable that this member will be renamed.

this time appears to bear out such a correlation. By correlating the Sandstone H member with the basal Knapp, the problem arises of where the Sandstones E and G fit in the stratigraphic column. As the fossils of these beds definitely are Mississippian in age, it is tentatively being proposed that they also are basal Knapp in age. Whenever possible in this study, direct comparisons have been made between the fossil material from northwestern Pennsylvania, the Riddlesburg faunas, and the fauna of the inliers. Thus the comparisons of the forms have been made although the names given them may prove later to be incorrect.

Sandstone H evidently is disconformable with the underlying Sandstone G. It also is in discomformable contact with the overlying Conglomerate I as the latter may rest upon Sandstone G where the intervening Sandstone H is missing.

Berea stage

*Conglomerate I.** The conglomerate herein being termed Conglomerate I is the most widespread in Fayette County of any of the members thus far described in the three inliers. It was not positively identified in the inliers of the Conemaugh gorges through Laurel Hill and Chestnut Ridge. It consists of a massive conglomerate composed chiefly of rounded or oval, white quartz pebbles averaging pea size or somewhat larger imbedded in a matrix of coarse, grey sandstone. Occasional rose-quartz pebbles may be seen. Where the sandstone predominates the pebbles usually occur as lenses in a coarse sandstone. The long diameter of the pebbles usually tends to be aligned parallel to the bedding planes or to the planes of cross-bedding. Fossils seem to be lacking. It averages about 20 feet in thickness wherever found.

The exact equivalents of Conglomerate I are not known. However, if the underlying Sandstone H is part of the Knapp, it does not seem unreasonable to assume that this member might roughly be the equivalent of the Berea (Corry) sandstone which is reported to be conglomeratic over much of western Pennsylvania. Admittedly, this correlation is only tentative as the lack of fossils hinders exact correlation. This might be equivalent to all or part of what Willard recognizes as "Berea" along the Allegheny Front and in the area north of Harrisburg but in the latter case even greater correlation risks are run.

This member is disconformable with Sandstone H below and with the overlying, heavy, massive, non-fossiliferous Sandstone J.

The type locality of this conglomerate is along the road from Victoria to Rock Spring school. It is also well exposed on the south bank of the Youghiogheny River opposite Victoria above the Western Maryland Railroad tracks.

KINDERHOOK SERIES

Shenango and Meadville stages (?)

Sandstone J.† Owing to the confusion concerning the use of the term "Pocono" and due to the fact that almost 200 feet of the basal beds of what was formerly called "Pocono" in western Pennsylvania have, because of faunal evidence, in this report been separated from the main body of the old "Pocono" formation, it seems advisable that some revision of the use of the term in the inliers should be made. "Pocono" has usually been applied to the massive, non-fossiliferous sandstones and shales that underlie the Loyalhanna sandy limestone (or more properly a limy sandstone) and overlie the Devonian beds, which are red in some places and non-red in others. It does not seem advisable to restrict the term "Pocono" to the

* When a more definitive study of this area is published, it is probable that this member will be named the Lick Run conglomerate.

† When a more definitive study of this area is published, it is probable that this member will be named the Chestnut Ridge sandstone.

beds above the lower, fossiliferous part of the old "Pocono" and as a consequence a new name should be proposed for these upper non-fossiliferous sandstones and shales. In this report these beds are being termed Sandstone J and include all the sandstones and shales between Conglomerate I (tentatively correlated with the Berea) and the base of the Loyalhanna (Greenbrier) limestone.

Sandstone J consists of massive, cross-bedded sandstone with some few interbedded grey, micaceous, thin-bedded shales. The cross-bedding in some of the sandstones is very marked. Numerous disconformities within the member indicate a very irregular mode of deposition or an area near enough sea level to be subjected often to erosion. However, the sandstones, although they are rather coarse grained, seem to be fairly well sorted. Numerous macerated plant fragments in the sandstones would seem to indicate or suggest either fresh water or a brackish water environment fairly near a shore, yet enough exposed to the action of currents or waves that some sorting could take place. Some of the interbedded shales are very like marine shales in every respect except they have yielded as yet no marine fossils.

These sandstones and shales range in thickness from 142 to 700 feet. It must be noted here, however, that almost all these exposures are on the flanks of anticlines and several, such as the exposure below milepost 59 on Route 40, show considerable interbed faulting, which make it impossible to tell what the thickness of the formation was before the faulting occurred. It is also likely that in the interval after the deposition of Sandstone J erosion removed some of the upper part of these sandstones. This must certainly have been the case near Victoria where the thickness is only 142 feet.

At the present state of the knowledge of these Mississippian members of western Pennsylvania, it is dangerous to suggest correlations. It seems reasonable from the standpoint of stratigraphic position alone that part of and perhaps all of the Meadville and Shenango stages may be present in this upper part of the old "Pocono." As yet this cannot be proved. The upper massive part of Sandstone J is apparently equivalent to the "Burgoon" sandstone of authors, but as that name apparently was proposed only for the extreme uppermost part of the old "Pocono" elsewhere, it does not seem right to extend it to cover all the sandstones and shales herein included under the term Sandstone J. Willard has indicated that the "Pocono" of central Pennsylvania north of Harrisburg can be divided into three members, the "Berea" at the base, the Peters Mountain in the middle, and the "Burgoon" at the top. The lack of connecting outcrops makes it seem unreasonable at this time to attempt correlation with these three units or to carry his nomenclature into the inlier area. It is not at all certain that what is called "Pocono" in central Pennsylvania is the same thing as either the Pocono of the Pocono Plateau or the "Pocono" of western Pennsylvania.

Sandstone J is separated from the underlying Conglomerate I by a disconformity. A hiatus apparently exists at the top of the member beneath the overlying Loyalhanna limestone in most localities.

These sandstones are well exposed on the flanks of Chestnut Ridge in the gorges of the Youghiogheny and the Conemaugh Rivers and along Route 40 over the crest of the ridge east of Uniontown, Pennsylvania.

PALEONTOLOGICAL CONSIDERATIONS

A complete analysis of the faunas of these members must await further study. However, certain points appear pertinent enough to be stated. On the basis of the collections made during this study, several interesting facts concerning the faunas of both the Devonian and the Mississippian of the inliers, including the Riddlesburg shale fauna introduced for comparison, will be noted. After deducting some questionably identified fragments it

was found that out of a total of 165 remaining forms only 22 carry through from the Devonian to the Mississippian. At the end of the Devonian, 63 forms drop out; at the beginning of the Mississippian, 80 forms are introduced. The distribution of the various forms between the major members delimited can be seen on the faunal list accompanying this report.

It is true that many of the forms are only comparatively identified and many forms do not have specific identification. In some cases this is due to poor preservation, but in many cases, it is due to a large degree to the undescribed nature of the fauna of the Devonian and particularly the Mississippian of western Pennsylvania. Regardless of the specific label or lack of it, the forms were directly compared from locality to locality so that the faunal check list is as accurate as the present state of knowledge will permit. Because of the undescribed nature of these faunas in western Pennsylvania, it is difficult to use faunal lists for correlation over very wide areas. When possible the fossils of the inliers were directly compared with northwestern Pennsyvania forms in the collections of the University of Cincinnati.

The most characteristic forms of the various members of the Devonian and the Mississippian of the inliers are indicated under the discussion for each member. Of the Devonian, the most characteristic forms are the "*Spirifer*" *disjunctus* gens (in abundance as it goes into the Mississippian but the individuals in the latter are few), *Camarotoechia sappho* (doubtfully goes into the Mississippian but only a few specimens were found), *Prorhyncus quadratum*, and *Ptychopteria*. Of the Mississippian, the most characteristic forms are *Syringothyris* cf. *angulata*, *Eumetria scansa*, *Leptodesma mentor* varieties (usually large forms), and the various forms of *Palaeoneilo*. In short, the line of division between the Devonian and Mississippian in this area could almost be drawn where "*Spirifer*" *disjunctus* gens in abundance stops and *Syringothyris* starts.

TABLE III

Biotic chart of the Upper Devonian and Lower Mississippian of southwestern Pennsylvania

	A[1]	B & C	D	E	G	H	Riddlesburg shale
Athyris cf. angelica Hall		x	x	x	x		
A. angelica var. nov.				x			
Camarotoechia aff. alleghania (Williams)			x				
C. contracta Hall			x	x	x	x	x
C. cf. contracta Hall				x			
C. aff. contracta Hall	x		x	x			x
C. (?) sappho Hall		x	x	x			
C. aff. sappho Hall			x				x
Chonetes acutiliratus Girty							x
C. scitulus Hall						x	
C. sp.			x				
C. sp.				x	x		
Crania (?) sp.			x				

TABLE III—Continued

	A[1]	B & C	D	E	G	H	Riddlesburg shale
Eumetria seansa (Hall)				x	x		
Lingula randalli Girty				x			
L. cf. scutella Hall					x		
L. sp.		x	x				
Oehlertella (?) cf. pleurites Meek			x	x	x		x
O. sp.				x			x
Orbiculoidea aff. randalli Hall			x	x	x		
O. sp.			x				x
Orthotetes sp.				x			
Productella cf. hirsuta Hall			x			x	
P. cf. onusta Hall					x		
P. cf. speciosa Hall				x	x		
P. sp.				x			
Rhipodomella huntingdonensis Girty							x
R. cf. huntingdonensis Girty						x	
Schellwienella sp.				x	x	x	x
Schuchertella ehemungensis (Conrad)			x				
S. ? sp.[2]				x			
Spirifer compositus Girty							x
S. disjunctus Sowerby	x	x	x	x			
S. disjunctus var. "warrenensis" Caster ms.		x	x				
S. disjunctus var. "pine-knobensis" Laird ms.					x	x	
S. sp. (immature)[2]						x	
Strophalosia muricata (Hall)			x				
Syringothyris cf. angulata simpson				x	x	x	x
S. cf. randalli Simpson						x	
S. sp.							x
Aviculopecten aff. duplicatus (Hall)			x				
A. aff. celsus Hall					x		
A. patulus Hall			x				
A. aff. patulus Hall					x		
A. striatus Hall			x				
A. sp. (large smooth)			x				
A. sp.			x				

TABLE III—Continued

	A[1]	B & C	D	E	G	H	Riddlesburg shale
Cypricardinia consimilis Hall							x
C. cf. consimilis Hall						x	
C. aff. consimilis Hall						x	
C. sp. 1							x
Edmondia cf. burlingtonensis (White & Whitfield)					x		
E. ellipsus Hall					x		
E. cf. ellipsus Hall[3]					x		
E. cf. phillipi Hall					x		
E. cf. subovata Hall			x		x		
"Elymella" cf. chadwicki Caster		x					
"E." sp. 1		x					
"E." sp. 2		x					
Goniophora cf. alata Hall				x			
G. cf. chemungensis Vanuxem			x				
G. aff. chemungensis Vanuxem				x			
G. cf. glaucus Hall				x			
G. sp.				x			
Grammysia communis Hall			x				
G. aff. duplicata Hall			x				
G. cf. hannabelensis (Shumard)				x	x		
G. cf. subarcuata (Hall)			x				
G. aff. undata Hall			x				
G. sp.					x?		
G. (?) sp. (long form)			x				
Leda aff. spatula Herrick[4]							x
Leptodesma aff. disparile Hall			x				
L. aff. jason Hall	x						
L. aff. lichas Hall	x						
L. maclurii Hall			x				
L. aff. matheri Hall						x	
L. mentor var. alpha Caster				x	x		
L. mentor var. maxima Caster				x	x		
L. mentor var. orodes Caster[5]				x	x		
L. mentor var. sulcata Caster				x	x		

TABLE III—Continued

	A[1]	B & C	D	E	G	H	Riddlesburg shale
L. cf. mortoni Hall			x				
L. orodes Hall	x		x				
L. cf. orodes Hall	x						
L. potens Hall		x	x				
L. cf. sociale Hall	x		x				
L. aff. sociale Hall				x	x		
L. cf. stephani Hall			x				
L. sp. 1	x						
L. sp. 2		x					
L. sp. 3			x				
L. sp. 4				x			
L. sp. (immature)[2]			x				
Modiola (Mytilops) praecedens Hall				x			
M. cf. praecedens Hall		x					
Modiomorpha aff. concentricus (Conrad)					x		
Mytilarca cf. simplex Hall				x	x	x	
Oleanella sp.	x						
Palaeanatina solenoides Hall	x						
Palaeoneilo cf. brevis Hall			x	x	x		
P. aff. brevis Hall						x	
P. concentricus Winchell							x
P. concentricus Winchell var. 1						x	x
P. concentricus Winchell var. 2, 3						x	
P. elongata Hall			x				
P. cf. elongata Hall					x	x	x
P. aff. maxima (Conrad)				x?	x		
P. sp. 1[6], 2				x	x		
P. sp. 3, 4, 5				x			
P. sp. 6, 7, 8, 9					x		
P. sp. (Dev.)			x				
Pararca neglecta Hall			x				
P. sao Hall			x				
P. cf. sao Hall					x		
P. transversa Hall			x				

TABLE III—Continued

	A[1]	B & C	D	E	G	H	Riddlesburg shale
P. cf. venusta Hall					x		
P. sp.					x		
Paracyclas rotunda (Hall)					x		
P. (?) sp.[2]			x	x			x
Prorhynchus quadratum Hall			x				
Pteronites cf. profundus Hall	x						
P. (?) sp.[2]	x						
Ptychopteria cf. beecheri Hall			x				
P. cf. eucrate Hall			x				
P. cf. sao Hall			x				
Sanguinolites undulatus Hall			x				
Schizodus aff. appressus (Conrad)	x			x			
S. aff. chemungensis (Conrad)	x					x	
S. aff. chemungensis var. quadrangularis Hall	x		x				
S. cf. contractus Hall			x	x			
S. aff. patulus (Hall)		x					
S. sp. 1, 2	x						
Paleosolen sp.				x			
Sphenotus cf. arcuatus Hall	x						
S. clavulus Hall			x				
S. aff. clavulus Hall		x	x				
S. contractus Hall	x		x				
S. cf. contractus Hall			x	x			
Sphenotus palmerae Caster			x				
S. sp.		x					
S. sp. (new genus?)			x				
Pelecypod indet. no. 1[2]		x	x				
Pelecypod indet. no. 2[2]				x			
Pelecypod indet. no. 3[2]				x	x		x
Pelecypod (large)[2]			x				
Pectinoid pelecypod[2]			x				
Bellerophon sp.			x	x			
Conularia sp.						x	x
Igoceras cf. breve Simpson					x		
Loxonema sp.				x			

TABLE III—Continued

	A[1]	B & C	D	E	G	H	Riddlesburg shale
Pleurotomaria aff. hickmanensis Winchell[4]							x
P. sp. 1 (small)	x		x	x			
P. sp. 2 (large)			x				
"Spirorbis" sp.							x
Pteropod		x		x	x	x	
Bradfordoceras sp.		x		x			
B. (?) sp.						x	
Neocycloceras obliquum Flower & Caster		x	x	x	x		
N. (?) sp.[2]				x			
Cephalopod (Nautiloid)?[2]			x			x	
Bryozoa, Trepostomata[2]			x				
Bryozoa, frondose[2]			x	x	x		
Bryozoa, incrusting[2]			x				
Bryozoa, ramose[2]	x		x		x		x
Rhopolonaria sp.				x			
Ctenodus nelsoni Newb.				x			
Fish scales		x	x				
Scaphiocrinus sp.							x
Crinoid stems[2]			x		x		x
Titusvillia sp. nov.						x	
Dictyosponge				x	x		
"Protolimulus" trail		x		x			
"Worm" burrows	x	x	x				
Ostracods?[2]							x
Echinocaris socialis Beecher			x				
Plants[2]	x			x	x		x

[1] Sandstone A is being assigned only tentatively to the Conneaut stage.
[2] Form excluded from faunal count because of indeterminate nature.
[3] This pelecypod of *Edmondia* aspect may be a new genus. It is possible that all forms of *"Edmondia"* identified in southwestern Pennsylvania may belong to an undescribed genus.
[4] Girty, 1927.
[5] Similar to form shown by Caster as var. *orodes* but apparently not Hall's *orodes*.
[6] The *Palaeoneilo* species which are numbered may be assignable to a new genus of Protobranchiate mollusca. The dentition has not been determined from any of the material.